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SOILS OF THE EASTERN UNITED STATES AND THEIR USE—XXXVII.

THE HAGERSTOWN CLAY.

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THE HAGERSTOWN CLAY.

GEOGRAPHICAL DISTRIBUTION.

The Hagerstown clay is an extensive limestone soil found within the great valley of Virginia, the limestone valleys which are enfolded into the Appalachian Mountain system, and in the bluegrass region of Kentucky. It has been encountered in 12 different soil survey areas located in seven different States, and mapped to a total extent of 371,290 acres. It is probable that there are upward of three and one-half million acres of the type altogether.

Throughout the Appalachian region the floors of the principal valleys are occupied by limestone. A group of soils known as the Hagerstown series is derived from these limestones. The chief soil of the series, the Hagerstown loam, is very extensively developed. Associated with it in nearly all of the different valleys will be found smaller areas of the Hagerstown clay. Although farmed in the same general way, the two soils differ materially in their characteristics. It will be shown that these differences affect the agricultural occupation of the type very materially.

It is probable that additional extensive areas of the Hagerstown clay will be found in northern Alabama, northwestern Georgia, eastern Tennessee, and the bluegrass region of Kentucky. Large areas are already known to exist through the great valley of Virginia (the Shenandoah Valley), and in the Hagerstown Valley of Maryland. A large number of smaller valleys lying to the west of the great valley also contain considerable areas of the Hagerstown clay. It is thus a widely developed and extensive soil type of high value for agricultural purposes.

CHARACTERISTICS OF SOIL AND SUBSOIL.

The soil of the Hagerstown clay is uniformly a dark reddish brown or deep-red clay loam or clay, decidedly silty, but somewhat sticky and plastic owing to the presence of a large amount of clay, particularly over areas where the surface soil is shallow. The depth is extremely variable in different areas ranging from 2 or 3 inches on

the sloping or rolling land to 10 or 12 inches over the more level areas, or where surface soil has accumulated through the washing of higher lying areas. The subsoil in the majority of areas where the type has been encountered is a stiff, heavy red clay extending to a depth of 3 feet or more. In some areas, however, the immediate subsoil is yellowish or reddish yellow in color, and the deep, characteristic red color is not encountered until a depth of 2 or 3 feet is reached. In all cases the subsoil rests upon the underlying rock. This is usually a fine-grained, massive, gray or blue limestone, although in some areas marbleized limestone gives rise to this soil. In the bluegrass region of Kentucky thin beds of shale which are associated with the limestone contribute to the material which forms this type.

In all the northern areas of its occurrence the surface soil of the Hagerstown clay is prevalently granular and in good mechanical condition. In many of the more southern areas where erosion has been excessive the surface soil is a stiff, hard clay, very difficult to till, and for that reason the type is not generally occupied for agricultural purposes in these latter areas.

The Hagerstown clay is easily distinguished from the Hagerstown loam, with which it is associated, by the stiff, plastic character of both the surface soil and the immediate subsoil in the majority of areas where it occurs. These two types and the associated members of the Hagerstown series are easily distinguished from the other soils in the region in which they occur through the fact of their derivation from limestone rock in a valley position. The soils of the Hagerstown series are distinguished from those of the Clarksville series through the fact that the soils are brown or reddish brown and subsoils usually a deep red or reddish brown, while the surface soil of the Clarksville types is usually gray and the subsoil yellow or reddish yellow.

SURFACE FEATURES AND DRAINAGE.

The Hagerstown clay, while occurring in valley or basin positions, is neither level nor of low elevation. It is found principally upon the rolling surface of valley floors, upon low ridges, and even upon the isolated rounded hills or on interrupted ranges within the broader limestone valleys. In the bluegrass region of north-central Kentucky the Hagerstown clay occupies rolling to steeply sloping upland positions, where numerous small hills are separated by deeply cut stream channels. As a result of this topographic position the natural surface drainage of the soil is usually complete. In fact, upon all of the steeper slopes, particularly in the more southern areas of its occurrence, the drainage is so complete that erosion constitutes a serious problem in the cultivation of the type.

In absolute elevation above sea level the surface of the type varies greatly in the different areas where it is found. In general the greater part of the type is found at altitudes ranging from 850 to 1,000 feet, although the ridges in some sections of the valleys where it is found will rise to altitudes in excess of 1,000 feet. These minor irregularities of elevation are rarely very great and the lower-lying portions of the type in any single area will usually be at an altitude of 200 to 300 feet lower than the highest occurrences of the type. Numerous steep slopes and rock ledges found within the area of Hagerstown clay frequently cause a considerable proportion of the type to be used only for pasturage or left in forest. In this respect the type is at something of a disadvantage when compared with the rolling or nearly level surface of the Hagerstown loam.

The natural surface drainage of the type is usually good and inclined to be excessive. Nevertheless, on account of the stiff, plastic condition of the surface soil and subsoil, water is held within the soil mass, and if proper tillage methods are employed an abundance of soil moisture may be stored for the maturing of crops. Where the surface soil has a depth of only 2 or 3 inches, the type is inclined to be somewhat droughty because of poor natural facilities for the absorption of rain water.

In all the more southern areas of its occurrence the heavy annual precipitation causes considerable erosion of the surface soil. In such regions a large proportion of the surface of the type has been so denuded of friable surface soil that not over 15 per cent of the total area can be used for the cultivation of crops. The prevention of this erosion is one of the serious problems connected with the tillage of the type in all of the more southern areas.

LIMITATIONS IN USE.

The Hagerstown clay, because of its characteristic stiff texture and condition, is somewhat limited in its crop adaptation. The almost universal experience of farmers who are dealing with this type seems to be that corn is not so well suited to production upon this soil as upon the Hagerstown loam. There is some exception to this rule, however, in that areas of Hagerstown clay which possess a total depth of 8 to 10 inches of reasonably mellow surface soil are certainly well adapted to corn production, giving yields ranging from 50 to 75 bushels per acre. In general, however, the surface soil is somewhat too heavy to constitute an ideal seed bed for the corn crop. In consequence, wheat and grass are better suited to this type and large yields of both of these crops are produced upon it. This limitation in the use of the type is inherent with the soil itself and may not usually be changed except at a considerable expense in the tillage of the soil.

The principal limitation upon the extensive occupation of the Hagerstown clay lies in its tendency to erode readily unless the surface soil is protected by grass covering or by some other form of vegetation, particularly during the torrential rains of the winter months. The stiff and impermeable character of the surface soil and subsoil renders the absorption of the rainfall rather slow. As a result, with sudden showers, a large proportion of the rain falling upon the land flows across its surface and is not absorbed by the soil. Under such circumstances, particularly when the subsoil is a stiff, heavy, and compact clay, the erosion of the fertile surface soil is rapid and destructive. In consequence the prevention of erosion upon the type constitutes one of the chief problems in its wider occupation and also limits the area of the lands which may be used for the cultivation of any tilled crops.

The presence of outcropping ledges of rock and of especially stony areas over a considerable portion of the Hagerstown clay, also constitutes a limitation upon the uses to which the type may best be put. These areas, while not constituting more than 25 per cent of the total area of the type, are of wide general distribution throughout its occurrence. The presence of the stones, and particularly of the rock ledges, interferes with the tillage of the type and, in consequence, such areas are best devoted to the production of bluegrass, which grows luxuriantly and which constitutes an excellent pasturage. Thus through its topographic condition, and through the presence of an excessive amount of stones, a portion of the type should be devoted to pasture rather than to tillage.

The Hagerstown clay occurs through a considerable range of climatic environment. The more northern areas are generally devoted to the production of corn, wheat, oats, and grass, while in the more southern areas the type is given over to the production of corn and cotton, with small areas of wheat and grass. It is probable that even in the more southern areas the better farm practice would be to eliminate cotton, which is not grown to particularly good advantage, and to occupy this type for the production of grain and forage crops.

IMPROVEMENTS IN SOIL EFFICIENCY.

The prevention of excessive erosion over the more steeply sloping portions of the Hagerstown clay constitutes one of the most important needs of this soil. All areas which have a slope in excess of 10 degrees should either be left in forest or should be placed in bluegrass sod to furnish grazing, and at the same time to prevent excessive erosion. There are, however, many areas with less slope which are subject to serious annual washing. Such areas would be improved by filling the gullies already formed with brush and other

refuse, the introduction of the terrace system of planting, and by contour cultivation. It is also desirable that after the removal of an intertilled crop, such as cotton or corn, some winter grain should be sown upon the soil, in order that its vegetation and roots may prevent the excessive erosion to which this soil is frequently subject during the winter months. These methods would be sufficient to reclaim thousands of acres which are now lying idle.

Erosion not only results in a bodily removal of all of the surface soil but also a considerable portion of the subsoil upon the more steeply sloping areas. The less easily detected erosion which removes a small proportion of the surface soil each year has frequently reduced the surface soil of the Hagerstown clay to a minimum depth of 2 or 3 inches. While this depth is maintained by the ordinary processes of cultivation, still there is annually a decided loss of fertile surface soil through washing. In order that the surface soil of the type may be deepened, made more friable and more retentive of moisture, it is extremely desirable that the depth of plowing should be gradually increased until an average depth of not less than 6 inches is attained. This will form a permeable surface layer competent to absorb a larger proportion of the annual precipitation and capable of giving a better root hold to the growing crops.

It is essential that the reincorporation of organic matter should be practiced in conjunction with the deeper plowing of the type. For this purpose, the growing of mixed grasses, clover and timothy, as a part of the regular rotation upon the farm, and the turning under of the sod for the growing of the intertilled crops, either corn or cotton, in regular rotation is considered the best practice. In areas where such a rotation is systematically practiced, very little difficulty is found either with the exhaustion of organic matter in the surface soil or with serious erosion, except upon the most steeply sloping areas. Where it is not possible to maintain the organic matter content and texture of the surface soil in good condition through the ordinary practices of crop rotation, it is extremely desirable that some winter cover crop like winter wheat or winter rye should occasionally be grown to be plowed under in the spring for the reincorporation of organic matter in the surface soil after the winter crop has served its purpose of preventing serious erosion. Wherever it is possible the use of some leguminous cover crop like cowpeas, sown late in the season, or soy beans, or even crimson clover, is to be recommended. The benefits to be derived from a leguminous crop are considerably greater than from any of the small grains thus used.

The systematic rotation of crops upon the Hagerstown clay is to be recommended in all of the areas where it occurs. Corn or export tobacco constitutes an excellent intertilled crop to be planted upon freshly plowed sod. Either crop can well be followed by winter

wheat which gives high yields upon this soil. Following the wheat, mixed clover and timothy should be grown for a period of two years, when the rotation should return to the intertilled crops. In connection with the growing of any of the leguminous crops, the application of lime to the surface soil is highly desirable. In some areas the burned stone lime is applied once in the four or five year rotation, at the rate of 1 to 1½ tons per acre. Where this practice has been continued through a long period of years the soil fertility of such areas has been well maintained. In place of the use of the burned lime, which is somewhat difficult to distribute, the ground limestone rock has more recently been applied. In such cases the applications amount to as high as 2 or 3 tons per acre, and the same purpose is served.

LIMITATIONS UPON SPECIAL CROPS.

The Hagerstown clay is essentially a general farming soil because of the heavy character of the surface clay loam soil and of the stiff, impervious clay subsoil. As a result of these characteristics the grasses and small grains are even better suited to this type than corn, although the latter crop is grown to good advantage where the surface soil has been well prepared. The Hagerstown clay is in no sense a special crop soil, and its uses should be limited to the heaviest type of general farming usually associated with dairying or the production and feeding of live stock of some kind.

EXTENT OF OCCUPATION.

The extent to which the Hagerstown clay is occupied varies greatly in the different areas where it occurs. In all of the more level regions of the limestone valleys and throughout the bluegrass region of central Kentucky probably 60 to 75 per cent of the total area of the type is occupied for some of the more intensive forms of agriculture. The remainder of the type is usually occupied for pasturage or for farm woodlots. There are limited areas of which only a small use is secured through grazing on account of their rougher topography and the presence of too great a quantity of loose stone in the surface soil. In more southern areas the greater surface slope of the type over a considerable proportion of its extent, and particularly the torrential winter rains, cause erosion to be so excessive that only 10 to 20 per cent of the total area of the type is occupied at present for agricultural purposes. It is thus evident that any extension in the occupation of the Hagerstown clay is dependent primarily upon methods of farming which shall prevent excessive erosion and which shall cause the surface of the type to be clothed with some form of vegetation through as great a portion of the crop rotation period as is possible. This can be accomplished largely by the growing of pasture grasses, to which the type is well suited.

CROP ADAPTATIONS.

The Hagerstown clay is best suited to the production of the small grains and of grass. It is probable that wheat occupies a larger acreage than any other single grain crop grown upon this soil. The yields produced vary considerably, depending upon the condition in which the soil has been kept and the skill of the individual farmer. In the more northern regions, particularly in the Shenandoah Valley, the wheat yields range from 20 to 35 bushels per acre, with an average of about 25 bushels. This high yield is the result of careful tillage methods and crop rotation. In other more southern areas, where the surface of the type is rougher or more steeply sloping and where a careful crop rotation is not so generally practiced, the yields of wheat range from 15 to 25 bushels per acre, which constitutes a high average yield for any soil type under the climatic conditions attendant upon wheat production in that region. The Hagerstown clay may therefore be characterized as a very valuable wheat soil upon which high yields may be maintained through some attention to the careful rotation of crops.

It is probable that grass occupies a greater area upon the Hagerstown clay than all other crops combined. Grass is grown not only for hay, but also over wide areas of almost permanent pasture. For the hay fields, a mixture of clover and timothy is seeded in the regular rotation, the yields of hay ranging from 1½ to 2½ tons per acre, dependent somewhat upon seasonal conditions and also to a considerable extent upon the care with which the land has been prepared before seeding. The bluegrass pastures on the Hagerstown clay are second only to those of the Hagerstown loam. Since a larger proportion of the total area of the Hagerstown clay is given over to pasturage than of its associated loam type, it is probable that the bluegrass pastures of the Hagerstown clay are fully as important as any other agricultural occupation of the type, with the possible exception of hay production. The bluegrass attains this maximum development in the second or third year from the time when it is seeded in. Then, if the pasture is not too heavily stocked, the stand of bluegrass will last for a number of years with only slight attention. In fact, in many areas the bluegrass naturally invades the field and no seeding is attempted upon the pasture land. Better grass stands may be secured by an occasional top seeding upon the sod, thus thickening the stand.

Corn is the other important crop of general production upon the Hagerstown clay. Its yields vary considerably in the different areas where the type has been encountered. Wherever the surface soil possesses a depth of 6 to 8 or 10 inches above the clay, the yield of corn is unusually high, ranging from 40 to 75 bushels per acre. Upon

areas which have suffered from erosion and which consequently have a depth of surface soil of less than 6 or 8 inches, the soil is unable to store a sufficient supply of moisture to carry the corn crop well through the drought of midsummer. In consequence, yields vary decidedly upon such areas, ranging from 10 or 12 bushels per acre, where the crop is raised practically upon the subsoil, to 25 or 30 bushels where the surface soil is in better condition.

Cotton is only produced to a limited extent upon the Hagerstown clay. Low yields are secured since the crop is frequently grown upon land which has been too seriously eroded to justify planting to any tilled crop. The cotton is also apt to become stained by a deep red surface soil where any of the lint is allowed to come in contact with it. In consequence, the Hagerstown clay can not be considered as an important cotton soil, even in the most southern areas where the climatic conditions are suitable for its production.

The Hagerstown clay is used particularly in north-central Kentucky for the production of heavy export tobacco. Fair to high yields are secured, ranging from 800 to 1,500 pounds per acre, with an average ranging between 1,000 to 1,200 pounds. Export tobacco has also been grown upon the Hagerstown clay in several Virginia areas, but its production on the type is decreasing rather than increasing. This arises from the fact that a regular rotation of corn, wheat, and grass is found more profitable than a one-crop system of tobacco culture.

In some areas apples have been planted upon the Hagerstown clay in positions which were particularly favored by deep soil, a somewhat friable subsoil and good local elevation. The varieties planted have been chiefly the Paragon, Ben Davis, and Newtown Pippin. The unusually heavy subsoil of this type is not considered favorable to commercial apple orcharding.

A much more extensive use should be made of cowpeas and soy beans in the regular rotation upon the Hagerstown clay, particularly in all of the more southern areas. The forage value of these crops is high, and their favorable influence upon the texture and the organic matter content of the soil, produced by plowing under the stubble, is found to be decidedly valuable in bringing the surface soil into better condition for the production of other crops. These crops are grown at the present time to a limited extent. Some sorghum is also produced in a few areas.

FARM EQUIPMENT.

The equipment of the various farms upon the Hagerstown clay in the different areas where the type occurs varies decidedly. Upon the rich, highly developed, and well-managed farms in the Shenandoah Valley the equipment consists of well-built farmhouses and barns, heavy work stock, and adequate farm machinery. In fact, upon this

type, both in Virginia and Kentucky, the breeding of horses and of mules has taken a considerable part in the development of the agriculture of the type. Heavy work stock and heavy farm tools are requisite to the proper tillage of such a dense, compact soil. The ordinary lightweight farm team can not possibly plow nor cultivate the surface soil in such a way as to bring out the best properties of this heavy clay soil. Where two or four mule or four-horse hitches are used in plowing or harrowing the type a favorable seed bed condition is produced, and large crops of corn, wheat, and grass may be grown. Where the one-mule hitch or the lighter farm team is employed it is only possible to scratch the surface of this heavy soil, and adequate and proper returns can not be anticipated.

There is considerable to be desired in connection with the equipment of the Hagerstown clay in the majority of areas where it occurs. The inherent properties of the soil itself mark it as one well fitted to produce the grain and grasses which form the basis for an extensive and profitable live-stock industry. In fact, the most profitable areas of the Hagerstown clay encountered have been those where the production of horses, mules, and beef cattle, and the feeding of dairy stock have been most highly specialized. Thus the type, which constitutes one of the heaviest of the general farming soils, is particularly well suited to the stock-raising and dairy industries.

SUMMARY.

The Hagerstown clay is an extensive limestone valley soil occurring throughout the valleys of the Appalachian Mountain region and of the bluegrass region of Kentucky.

The soil is particularly well suited to the production of wheat and grass, and upon properly tilled areas corn is also an important and profitable crop.

The topography of the type is usually rolling and sloping and the natural surface drainage is good. In all of the more northern areas of its occurrence practically 75 per cent of the total area of the Hagerstown clay is now occupied for cropping or for pasturage. In other areas erosion has greatly reduced the extent to which the type may be tilled.

The Hagerstown clay is characteristically a small-grain and grass soil, upon which the dairy industry should be developed to a high degree.

The planting of commercial orchards upon the type is not recommended.

Approved.

JAMES WILSON,
Secretary of Agriculture.

WASHINGTON, D. C., *March 6, 1912.*

APPENDIX.

The following table shows the extent of the Hagerstown clay in the areas surveyed at this time. In the first column is stated the particular soil survey in which the soil was encountered, in the second column its extent in acres, and in the third column the volume of the Field Operations of the Bureau of Soils in which the report upon the area may be found. Those desiring a detailed description of the soil and of the general conditions which surround it in any particular area may consult these volumes in almost any public library.

Areas of the Hagerstown clay encountered in the soil survey.

Survey.	Area of soil.	Date.[1]
Alabama:	*Acres.*	
Fort Payne area	3,968	1903
Huntsville area	9,024	1903
Georgia:		
Walker County	17,216	1910
Kentucky:		
Madison County	43,392	1905
Mason County	115,648	1903
Scott County	102,528	1903
Pennsylvania:		
Center County	6,592	1908
Lancaster area	2,000	1900
Tennessee:		
Greeneville area[2]	21,568	1904
Virginia:		
Albemarle area	25,920	1902
Bedford area	19,210	1901
West Virginia:		
Leesburg area	4,224	1903

[1] Year of publication, Field Operations.

[2] Mapped as Decatur clay.

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